	Percent time-spent-following may reach 65 percent. Average speed still exceeds 45 mph on level terrain, even though unrestricted passing demand exceeds passing capacity.
D	Passing demand is very high, while passing capacity approaches zero. Mean platoon sizes of 5 to 10 vehicles are common, although speeds of 40 mph can still be maintained under ideal conditions. The fraction of no passing zones along the roadway section usually has little influence on passing. The percentage of time motorists are delayed approaches 80 percent.
E	Defined as traffic flow conditions on two-lane highways having a percent time-spent-following of greater than 80 percent. Speeds may range from 25 to 40 mph. Passing is virtually impossible and platooning becomes intense.
F	As with other highway types, LOS F represents heavily congested flow with traffic demand exceeding capacity. Volumes are lower than capacity, and speeds are highly variable.

Table PN.06-1 Two-Lane Highway Operational Characteristics from 2000 HCM

To determine rural operation levels, the study team divided the corridor into three sections. Since the WIS 64 section is 12.2 miles long with slightly different traffic volumes west and east of US 63/WIS 46, it was divided into Section 1 and Section 2. Section 3 then covers the US 63 segment from WIS 64 to the Polk County line. Figure PN.06-7 illustrates the sections along WIS 64 and US 63.

The study analyzed each section using the 2000 Highway Capacity Software's (HCS) two-lane analysis for 2002, 2012, 2022, and 2032 traffic volumes. Tables PN.06-2 (WisDOT Projections) and PN.06-3 (Historical Trends Projections on page 2-6) show the LOS for each two-lane section for these conditions. Note that LOS C is considered the lower limit of acceptable operations on Corridors 2020 routes such as the study corridor.

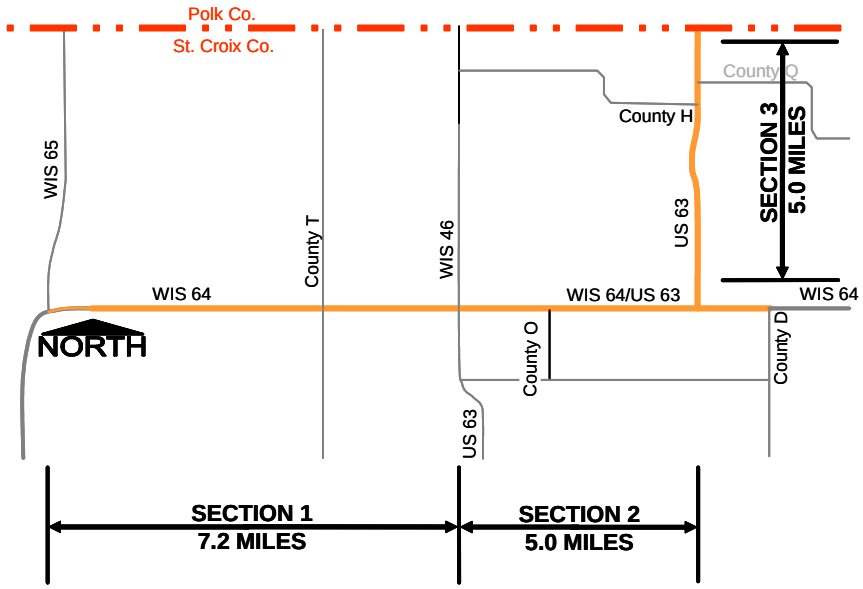

Figure PN.06-7 Two-Lane Section Locations

Section	2002	2012	2022	2032
1	ADT = 5,471 vpd PHV = 461 vpd % Passing = 71% LOS C	ADT = 6,128 vpd PHV = 515 vpd % Passing = 71% LOS C	ADT = 7,276 vpd PHV = 596 vpd % Passing = 71% LOS C	ADT = 8,642 vpd PHV = 690 vpd % Passing = 71% LOS C
2	ADT = 4,840 vpd PHV = 448 vpd % Passing = 60% LOS C	ADT = 5,340 vpd PHV = 518 vpd % Passing = 60% LOS C	ADT = 6,380 vpd PHV = 601 vpd % Passing = 60% LOS C	ADT = 7,630 vpd PHV = 697 vpd % Passing = 60% LOS C
3	ADT = 3,320 vpd PHV = 303 vpd % Passing = 61% LOS B	ADT = 3,940 vpd PHV = 360 vpd % Passing = 61% LOS C	ADT = 4,680 vpd PHV = 428 vpd % Passing = 61% LOS C	ADT = 5,560 vpd PHV = 508 vpd % Passing = 61% LOS C

Table PN.06-2 Two-Lane Operation Levels – WisDOT Traffic Projections

Section	2002	2012	2022	2032
1	ADT = 5,471 vpd PHV = 451 vpd % Passing = 71% LOS C	ADT = 8,206 vpd PHV = 659 vpd % Passing = 71% LOS C	ADT = 11,488 vpd PHV = 901 vpd % Passing = 71% **LOS D**	ADT = 16,084 vpd PHV = 1,232 vpd % Passing = 71% **LOS D**
2	ADT = 4,840 vpd PHV = 448 vpd % Passing = 60% LOS C	ADT = 7,260 vpd PHV = 671 vpd % Passing = 60% LOS C	ADT = 10,164 vpd PHV = 939 vpd % Passing = 60% **LOS D**	ADT = 14,230 vpd PHV = 1,315 vpd % Passing = 60% **LOS D**
3	ADT = 3,520 vpd PHV = 322 vpd % Passing = 61% LOS B	ADT = 5,280 vpd PHV = 482 vpd % Passing = 61% LOS C	ADT = 7,392 vpd PHV = 675 vpd % Passing = 61% LOS C	ADT = 10,349 vpd PHV = 945 vpd % Passing = 61% **LOS D**

Table PN.06-3 Two-Lane Operation Levels – Historical Traffic Growth Trends

Using WisDOT Central Office traffic projections, the current sections operate at LOS C and will continue to operate at LOS C through 2032. In 2032, Section 2 will operate close to the LOS D threshold.

Using traffic projections based on historic trends, all of the study corridor will operate at LOS D by 2032. The current sections operate at LOS C, yet most will fall to LOS D by 2022. At LOS D, vehicles can be delayed up to 75% of the time and mean platoon sizes can range between five to ten vehicles. Also, at LOS D, the available passing opportunity begins to have little effect on highway operations. This means that improving the amount of highway where passing is allowed will have little effect on the LOS. In this scenario, a roadway project that improves the passing percentage by 20% will have much less effect on an LOS D road than it would on a roadway operating at LOS C or B. This is because at LOS D, the amount of traffic in the opposing lane prevents passing and becomes a controlling factor. Also, under these conditions platoons grow very large, preventing vehicles from passing. However, during the nonpeak periods, increasing the passing opportunity will have a positive impact on operations.

D. Intersection Operation

The operation of a roadway (e.g., congestion levels) is typically described as Level of Service (LOS). The LOS rating system describes the traffic flow conditions of a roadway or intersection and ranges from A (free flow conditions) to F (over capacity). In urban areas, intersection operation is the primary evaluation measure for operation levels. Intersection operation is less of a measure of operation in rural areas, yet it still provides insight on how difficult it may be to enter and cross the highway.

For intersections, LOS is determined by the average delay (in seconds) of vehicles entering the intersection. The average delay is based on the peak 15-minute period of the peak hour being analyzed. Since this delay is an average value, some vehicles will experience greater delay, and some will experience less delay than the average value. Intersections with short average delays have high LOS; conversely, intersections with long average delays have low LOS. LOS E is often considered to be the limit of acceptable delay and LOS F for the total intersection is considered to be an indication of the need for improvement. Many communities establish a delay of up to 55 seconds for signalized intersections and 35 seconds for unsignalized intersections, both corresponding to LOS D, as their minimum standard. Corridors 2020 Routes strive to maintain LOS C operations or better.

LOS characteristics are different for signalized and unsignalized intersections. Drivers anticipate longer delays at signalized intersections that carry large amounts of traffic. However, drivers generally feel unsignalized intersections should have less delay. Additionally, several driver behavior considerations combine to make delays at unsignalized intersections less desirable than at signalized intersections. For example, drivers at signalized intersections are able to relax during the red interval, whereas drivers on the minor approaches to unsignalized intersections must remain attentive to identify acceptable gaps for entry. Typically, LOS is only calculated for the legs of an unsignalized intersection that have to yield to other movements (stop control or left turns). Table PN.06-4 describes LOS characteristics for both signalized and unsignalized intersections.

LOS	Signalized Intersections	Unsignalized Intersections
A	Describes intersections with very low levels of delay that average less than 10 seconds per vehicle. This condition occurs with extremely favorable signal progression and most vehicles arrive on the green phase of the signal.	Describes intersections with very low levels of delay that average less than 10 seconds per vehicle.
B	Describes intersections with low levels of delay that are more than 10 seconds yet less than 20 seconds per vehicle. This condition generally occurs with short-cycle lengths and/or good signal progression.	Describes intersections with low levels of delay that are more than 10 seconds yet less than 15 seconds per vehicle.
C	Describes intersections with average delays ranging from 20 to 35 seconds per vehicle. Individual cycle failures (waiting through more than one cycle) may appear at this Level of Service. The number of vehicles stopping is also substantial at this Level of Service.	Describes intersections with average delays ranging from 15 to 25 seconds per vehicle.
D	Describes intersections with average delays ranging from 35 to 55 seconds per vehicle. The influence of congestion becomes more noticeable. This Level of Service may result from long-cycle lengths, unfavorable progression and/or high vehicle-to-capacity ratios. Many vehicles stop and the proportion of nonstopping vehicles declines. Individual cycle failures are noticeable.	Describes intersections with average delays ranging from 25 to 35 seconds per vehicle. The influence of congestion becomes more noticeable.
E	Describes intersections with average delays ranging from 55 to 80 seconds per vehicle. Individual cycle failures are frequent occurrences. This Level of Service is considered by most agencies to be the limit of acceptable delay.	Describes intersections with average delays ranging from 35 to 50 seconds per vehicle.
F	Describes intersections with average delays that are more than 80 seconds per vehicle. This Level of	Describes intersections with average delays that are more than 50 seconds per vehicle. LOS F

LOS	Signalized Intersections	Unsignalized Intersections
	Service, considered to be unacceptable by most drivers, often occurs with oversaturation. The number of vehicles entering the intersection exceeds the intersection's capacity.	exists where there are insufficient gaps of suitable size to allow side-street traffic to cross safely though a major street traffic stream. This LOS is usually evident from extremely long total delays fpr side-street traffic and queuing on the minor approaches.
Source: 1997 Highway Capacity Manual		

Table PN.06-4 Level of Services Characteristics

The study analyzed seven intersections to determine their operation levels. The locations of these intersections are illustrated in Figure PN.06-8. These intersections experience the greatest traffic volumes in the corridor and provide a representative sample of side road delays throughout the corridor.

Because most of the intersections are two-way stop-controlled, only the LOS for yielding movements is provided. In most cases, the through WIS 64 and US 63 movements experience little-to-no delay since these movements have the right-of-way. The one exception to this is US 63 South/WIS 46 intersection, which is four-way stop-controlled.

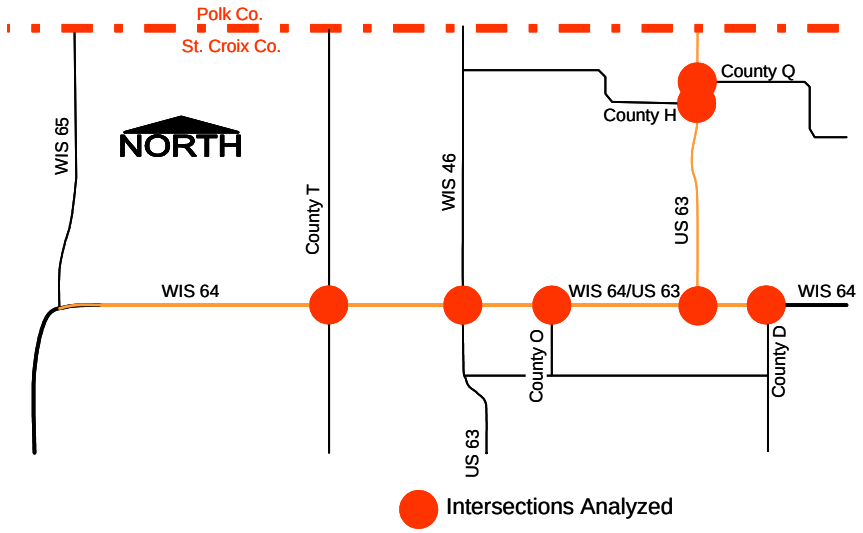

Figure PN.06-8 Intersections Analyzed

Table PN.06-5 shows the projected LOS for yielding movements using the conservative traffic projections provided by WisDOT Central Office. The analysis was performed using Highway Capacity Manual Software. There may be instances where temporary peaking characteristics produce delays that are greater than those shown in the table. Some of these peaks may occur on summer weekends. According to the analysis, with these traffic projections, most intersection movements will operate at acceptable levels through the year 2032. The four-way stop-controlled US 63 South/WIS 46 intersection begins to experience greater delays in the year 2032. Movements that operate at unacceptable levels are shaded.

	2002	2012	2022	2032
County T/WIS 64	EB L – A – 7.5 WB LTR – A – 8.0 NB LTR – A – 7.5 SB LTR – A – 7.3	EB L – A – 7.6 WB LTR – A – 8.1 NB LTR – A – 7.9 SB LTR – A – 7.5	EB L – A – 7.6 WB LTR – A – 8.3 NB LTR – A – 8.4 SB LTR – A – 7.8	EB L – A – 7.7 WB LTR – A – 8.5 NB LTR – A – 9.2 SB LTR – A – 8.1
US 63 South/WIS 64	EB A – B – 12.5 WB A – B – 10.5 NB A – A – 9.9 SB A – A – 10.2	EB A – B – 14.8 WB A – B – 11.5 NB A – B – 10.7 SB A – B – 11.1	EB A – C – 19.7 WB A – B – 13.1 NB A – B – 12.0 SB A – B – 12.6	EB A – D – 32.4 WB A – C – 15.8 NB A – B – 13.9 SB A – B – 14.8
County O/WIS 64	WB L – A – 8.2 NB LR – B – 11.7	WB L – A – 8.4 NB LR – B – 12.4	WB L – A – 8.6 NB LR – B – 13.4	WB L – A – 8.9 NB LR – B – 14.8
US 63 North/WIS 64	EB L – A – 7.7 WB L – A – 7.5 NB LTR – B – 14.9 SB L – B – 14.5 SB R – A – 9.1	EB L – A – 7.8 WB L – A – 7.5 NB LTR – C – 15.3 SB L – C – 16.5 SB R – A – 9.2	EB L – A – 8.0 WB L – A – 7.6 NB LTR – C – 17.0 SB L – C – 19.4 SB R – A – 9.4	EB L – A – 8.1 WB L – A – 7.6 NB LTR – C – 19.9 SB L – C – 24.3 SB R – A – 9.6
County D/WIS 64	EB – A – 7.4 WB – A - 7.7 NB LTR – B – 10.1 SB LTR – A – 9.9	EB – A – 7.5 WB – A - 7.8 NB LTR – B – 10.5 SB LTR – A – 10.2	EB – A – 7.5 WB – A - 7.9 NB LTR – B – 11.1 SB LTR – B – 10.7	EB – A – 7.5 WB – A - 7.9 NB LTR – B – 11.7 SB LTR – B – 11.0
County H/US 63	NB – A – 7.6 EB LR – B – 10.4	NB LT – A – 7.7 EB LR – B – 10.8	NB LT – A – 7.7 EB LR – B – 10.8	NB LT – A – 7.7 EB LR – B – 10.8
County Q/US 63	SB – A – 7.8 WB LR – B – 10.5	SB LT – A – 7.9 WB LR – B – 11.2	SB LT – A – 8.0 WB LR – B – 11.9	SB – A – 8.1 WB LR – B – 12.7
EB – Eastbound, WB – Westbound, NB – Northbound, SB – Southbound, L – Left, T – Through, R – Right, A – Approach				

Table PN.06-5 Intersection LOS Using WisDOT Central Office Traffic Projections

Table PN.06-6 shows the operation levels for corridor intersections using traffic projections based on historic trends. Movements that operate at unacceptable levels are shaded. The US 63 South/WIS 46 intersection begins experiencing unacceptable delays in 2012. By 2022 three intersections have movements with unacceptable operation levels and some of these delays exceed 100 seconds. By the year 2032, four intersection approaches have movements with unacceptable operation levels and delays that are so great the traffic software is unable to predict them accurately (as indicated by the double asterisk **).

	2002	2012	2022	2032
County T/WIS 64	EB L – A – 7.5 WB LTR – A – 8.0 NB LTR – A – 7.5 SB LTR – A – 7.3	EB L – A – 7.7 WB LTR – A – 8.4 NB LTR – A – 9.0 SB LTR – A – 8.0	EB L – A – 7.9 WB LTR – A – 9.1 NB LTR – F – 59.1 SB LTR – F – **	EB L – A – 8.2 WB LTR – B – 10.4 NB LTR – F – ** SB LTR – F – **
US 63 South/WIS 64	EB A – B – 12.5 WB A – B – 10.5 NB A – A – 9.9 SB – B – 10.2	EB A – D – 25.5 WB A – B – 14.6 NB A – B – 13.1 SB – B – 13.8	EB A – F – ** WB A – D – 26.4 NB A – C – 19.7 SB – C – 22.2	EB A – F – ** WB A – F – 90.5 NB A – E – 40.9 SB – F – 58.8
County O/WIS 64	WB L – A – 8.2 NB LR – B – 11.7	WB L – A – 8.8 NB LR – B – 14.7	WB L – A – 9.6 NB LR – C – 20.4	WB L – B – 11.1 NB LR – E – 36.8
US 63 North/WIS 64	EB L – A – 7.7 WB L – A – 7.5 NB LTR – B – 14.9 SB L – B – 14.5 SB R – A – 9.1	EB L – A – 8.1 WB L – A – 7.6 NB LTR – C – 19.4 SB L – C – 22.4 SB R – A – 9.5	EB L – A – 8.6 WB L – A – 7.8 NB LTR – D – 32.5 SB L – F – 54.0 SB R – B – 10.2	EB L – A – 9.7 WB L – A – 8.0 NB LTR – F – 96.3 SB L – F – ** SB R – B – 11.6
County D/WIS 64	EB – A – 7.4 WB – A - 7.7 NB LTR – B – 10.1 SB LTR – A – 9.9	EB – A – 7.5 WB – A - 7.9 NB LTR – B – 11.5 SB LTR – A – 11.0	EB – A – 7.6 WB – A - 7.7 NB LTR – B – 13.9 SB LTR – A – 12.5	EB – A – 7.7 WB – A – 8.7 NB LTR – C – 21.6 SB LTR – C – 15.2
County H/US 63	NB – A – 7.6 EB LR – B – 10.4	NB – A – 7.8 EB LR – B – 11.8	NB – A – 8.0 EB LR – B – 14.1	NB – A – 8.4 EB – C – 19.3
County Q/US 63	SB – A – 7.8 WB LR – B – 10.5	SB – A – 8.1 WB LR – B – 11.9	SB – A – 8.4 WB LR – B – 14.1	SB – A – 9.0 WB – C – 18.3
EB – Eastbound, WB – Westbound, NB – Northbound, SB – Southbound, L – Left, T – Through, R – Right, A – Approach ** Demand exceeds capacity; software unable to accurately predict delay				

Table PN.06-6 Intersection LOS Using Historical Trends Traffic Projections

E. Traffic Signal Warrants

The need for traffic signals is usually determined by using a set of criteria called Signal Warrants. Signal warrants are listed in the Manual on Uniform Traffic Control Devices and currently there are up to 15 criteria that can justify signals. Rarely is a signal installed at an intersection without meeting at least one signal warrant. Often signals are not installed even when several warrants are met because it is in the overall interest of the system to not introduce signal delay or queuing. The study team looked at the five most commonly met warrants for rural areas. The warrants analyzed were:

1. Warrant 1A: Minimum Vehicular Volume
2. Warrant 1B: Interruption of Continuous Traffic
3. Warrant 2: Four Hour Volume
4. Warrant 3: Peak Hour Volume
5. Warrant 7: Crash Experience

Fifteen-hour turning movement counts were performed at both the WIS 64/US 63 South/WIS46 intersection and the WIS 64/US 63 North intersection. The study team then analyzed the two intersections to see if they met warrants based on the 2002 counts. The study team also analyzed the intersections using both the low (WisDOT Central Office) and high (historic) range of traffic projections to see if the warrants would be met in the future. Please refer to Section PN.06(A) for a discussion on the range of traffic projections used for this study. Tables PN.06-7 and PN.06-8 below show the results of the warrant analysis.

Year / Warrant	2002	2012		2022		2032	
		low	high	low	high	low	high
W1A: Minimum Vehicle Interruption	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
W1B: Interruption of Continuous Traffic	No	No	No	No	**Yes**	No	**Yes**
W2: Four Hour Volume	No	No	No	No	**Yes**	**Yes**	**Yes**
W3: Peak Hour Volume	No	No	**Yes**	No	**Yes**	**Yes**	**Yes**
W7: Crash Experience	No	N/A	N/A	N/A	N/A	N/A	N/A

Table PN.06-7 WIS 64/US 63 S/WIS 46 Intersection – Traffic Signal Warrant Summary

Year / Warrant	2002	2012		2022		2032	
		low	high	low	high	low	high
W1A: Minimum Vehicle Interruption	No	No	No	No	**Yes**	No	**Yes**
W1B: Interruption of Continuous Traffic	No	No	No	No	No	No	**Yes**
W2: Four Hour Volume	No	No	No	No	**Yes**	No	**Yes**
W3: Peak Hour Volume	No	No	No	No	**Yes**	No	**Yes**
W7: Crash Experience	No	N/A	N/A	N/A	N/A	N/A	N/A

Table PN.06-8 US 63 N/WIS 46 Intersection – Traffic Signal Warrant Summary

At the WIS 64/US 63 South/WIS 46 intersection, none of the five warrants analyzed are currently being met. According to the high traffic projections, two warrants would be met in 2012, and four would be met in 2022. According to the lower traffic projections, one warrant would be met in 2022 and three would be met in 2032.

At the WIS 64/US 63 North intersection, none of the five warrants analyzed are currently being met. The low traffic projections do not show that any warrants would be met through the year 2032. The high projections indicate that three warrants would be met in 2022 and four would be met in 2032.

2.07 EXISTING DEFICIENCIES

The study team analyzed the corridor to determine whether it meets horizontal and vertical alignment criteria. WIS 64 and US 63 generally follow straight alignments, so the horizontal alignment meets criteria. Some portions of the vertical profile fall below current standards for a 60 mph design speed. The study team used three sets of plans to review the roadway alignments. The sets were from 1932, 1951, and 1961, with the most recent set being used whenever possible. Table PN.07-1 shows the station, plan set, and design speed of the substandard vertical curves along this corridor.

Station to	Station	Type	Plan set date	K	Design Speed
27+11	31+11	Crest	STH 64 1951	178	50
42+25	44+25	Crest	STH 64 1951	167	50
67+00	76+50	Crest	STH 64 1951	158	50
88+59	92+59	Sag	STH 64 1951	125	50
98+08	102+08	Sag	STH 64 1951	121	50
113+48	117+67	Sag	STH 64 1951	81	45
147+79	153+99	Crest	STH 64 1951	160	50
195+85	204+85	Sag	STH 64 1951	114	50
205+14	209+14	Sag	STH 64 1951	114	50
272+08	275+08	Sag	STH 64 1951	158	45
276+69	282+69	Sag	STH 64 1951	122	50
306+70	313+00	Sag	STH 64 1951	103	50
393+60	404+40	Crest	STH 64 1951	171	50
404+99	411+99	Sag	STH 64 1951	125	55
596+85	606+85	Crest	STH 64 1951	185	50
607+04	612+04	Sag	STH 64 1951	128	55
622+98	630+98	Crest	STH 64 1951	182	50
637+21	643+21	Sag	STH 64 1951	105	50
0+93	2+06	Crest	USH 63 1937	100	40
21+13	25+13	Crest	USH 63 1937	181	50

Table PN.07-1 Substandard Vertical Curves

PN.08 CORRIDOR PRESERVATION

As mentioned previously, this document evaluates the effects from the construction of the proposed alternative. The proposed alternative is needed because of those factors outlined in Sections PN.03 through PN.07. To efficiently and effectively construct this proposed alternative, corridor preservation measures will additionally be needed. Because the proposed alternative will be a phased construction process that may not be completed for 20 years or more, the future corridor needs to be protected so that development adjacent to the future highway is properly planned.